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Health Study of Airborne Manganese (Mn) Exposure in Ohio Adults

What is the Regional Applied Research Effort (RARE)?

An EPA program to promote ORD and Regional collaboration, RARE provides Regions with near-term research on specific high-priority science needs and fosters ORD-Regional interaction.

What is the project?

Two part study: "RARE Part 1" (2009) evaluated exposure to and effects of potential airborne Mn exposure in Marietta OH (near a Mn smelter) and Mt. Vernon OH (less exposed comparison community). "RARE Part 2" (2011) adds a similar evaluation in East Liverpool OH adults. The same researchers conducted both parts with similar methods to allow data comparison.

Why did we do a health study?

In order to (1) address citizen concerns and requests for a health study; (2) collaboratively address an OH EPA petition to ATSDR for a health evaluation of East Liverpool airborne metals (some of the highest US outdoor air Mn concentrations have been monitored in East Liverpool); and (3) improve science regarding exposure to and effects of chronic low level airborne Mn exposure in residential communities, a Region 5 concern for more than a decade.

Who collaborated on the study and what role did each play?

- ATSDR: funding (ambient monitoring), technical expertise (risk and modeling), community relations
- EPA-ORD: initial study proposal, funding, Project Officer, technical expertise, blood chemistry
- EPA-Region 5: initial study proposal, technical expertise (risk and modeling)
- Ohio Department of Health: community relations, technical review
- Ohio EPA: technical review, ambient monitoring
- San Francisco State University (SFSU) and collaborators: Grantee/Contractor/Principal Investigator, study design, health study data collection

How was the study conducted?

"RARE Part 1" was conducted in Marietta OH and Mt. Vernon OH; "RARE Part 2" adds East Liverpool. An **exposure index** (Mn ambient air concentration, residence duration, distance from source) was derived that included air dispersion modeling and air monitoring data. **Health data** were collected from questionnaires (general health, diet, medications etc.), medical and neuropsychological evaluation (interview, neurologic exam, blood sample etc.) and neurobehavioral tests (movement, balance, mood, etc.).

What are the study results?

For "RARE Part 1" – Marietta and Mt. Vernon OH (complete):

- published 2011 and 2012 journal articles cautiously interpreted subtle, subclinical effects (undetectable by lab test or clinical examination) on movement and anxiety

For "RARE Part 2" – East Liverpool OH (preliminary):

- No result differences between towns were observed for: general health, dietary Mn, blood Mn, blood lead, mood, tests of attention and memory

- Result differences between towns were observed for: generally slight or very mild subclinical effects where statistically significant differences were observed (e.g. tremor, postural sway, slower movement initiation)

Both Marietta and East Liverpool have elevated Mn air concentrations, but health effects potentially consistent with Mn exposure were fewer and more subtle than in worker studies with much higher exposures. Study results suggest that living closest to the Mn source for a longer time (i.e., more Mn air exposure) was associated with borderline to mild tremors and slightly lower motor speed and strength.

What mitigation steps have been taken?

State and federal inspections and air monitoring have been conducted in and near the sources in both Marietta and East Liverpool. Ohio EPA issued 2008 and 2010 Findings and Orders to the East Liverpool Mn source, S.H. Bell, requiring emissions and dust control, road paving and process changes that appear to have lowered monitored airborne Mn. The Marietta source, Eramet-Marietta, is subject to the ongoing Ferroalloys Production Risk and Technology Review rulemaking (final rule late 2013).

What are implications of the study?

The study has community, regulatory and science implications. The study may advance the understanding of airborne Mn exposure and toxicity, which can inform future guideline and regulatory decision making. EPA may further consider study results during EPA Integrated Risk Information System (IRIS) Mn reassessment and the Ferroalloys Production Risk and Technology Review rulemaking.

What steps are next?

- Citizens have already been notified of their personal test results
- Preliminary "RARE Part 2" results were presented at 7/11/13 East Liverpool Health Board and public meetings
- Refined results will be submitted to science journals for publication
- Continue East Liverpool and Marietta outdoor air Mn monitoring
- Region 5 enforcement office will continue oversight of S.H. Bell and compliance with Clean Air Act and Ohio Laws, regulations, Findings and Orders
- Assess need for additional enforcement actions